ANSWERS: Calorimetry calculations

1) i) $q = mc\Delta T = 50 \times 4.18 \times 6.5 = 1358.5 \text{ J} = 1.3585 \text{ kJ}$

n = c x V = 1 x 0.025 = 0.025 mol

$$\Delta_r H^\circ = \frac{-q}{n} = \frac{-1.3585 \text{ kJ}}{0.025 \text{ mol}}$$

$= -54.3 \text{ kJ mol}^{-1}$

ii) Conditions were not standard.
Needed to carry out under standard conditions.

OR
Heat lost to atmosphere / beaker / surroundings.
Insulate equipment; ensure all / as much of the energy produced as possible is collected and measured.

2) Conditions were not standard. Carry out under standard conditions.

Heat lost to atmosphere / beaker / by evaporation.
Insulate equipment, ensure all / as much as possible, of the energy produced is collected and measured.
Not complete combustion – make sure O_2 supply sufficient for complete combustion.

3) i) $n = 0.400 \text{ g} / 86.0 \text{ g mol}^{-1} = 0.00465 \text{ mol}$

Energy absorbed = $q = ms\Delta T = 150 \text{ g} \times 4.18 \text{ J g}^{-1} \text{ °C}^{-1} \times 17\text{°C}$

$= 10659 \text{ J} \ / \ 10.695\text{kJ} \ / \ 10.7\text{kJ}$

$\Delta H = -10\,659 \text{ J} / 0.00465 \text{ mol}$ **$= -2292$ or -2290 or -2300 kJ mol^{-1}**

ii) • Heat lost to the surroundings needs better insulation such as: lid on the beaker /lagging on the beaker /containment of the heat from the flame.
• Incomplete combustion occurs, ensure plenty of oxygen is supplied
• Not done under standard conditions make sure done at 25º and 1 atmosphere pressure

4) $50.0 \text{ g} \times 2.70^\circ\text{C} \times 4.18 \text{ J g}^{-1} \ ^\circ\text{C}^{-1} = 564.3 \text{ J}$

$n(NH_4NO_3) = 1.80 \text{ g} \div 80 \text{ g mol}^{-1} = 2.25 \times 10^{-2} \text{ mol}$

Energy absorbed when 1 mol dissolves $= 564.3 \text{ J} \div 2.25 \times 10^{-2} \text{ mol} = 25\,080 \text{ J}$

$\Delta_r H = +25.1 \text{ kJ mol}^{-1}$

5) i) $E = 200 \times 4.18 \times 18 = 15\,048$ joules = 15.048 kJ released
n(ethanol) = 1.00 g / 46 g mol–1 = 0.0217 mol
$\Delta c H = -15.048 \text{ kJ} / 0.0217 \text{ mol} =$ – 693 kJ mol-1

ii) 1. Heat is lost to the surroundings/lack of insulation.
2. Some of the ethanol that is burned undergoes incomplete combustion that releases less energy.
3. Experiment not carried out under standard conditions.